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THOUGHT LEADERSHIP BRIEF

Language Learning by Ageing Populations from Emerging Markets: an Empirical Study in China

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KEY POINTS

- Learning a new language may enhance cognitive ability and health in older adults. Sleep facilitates language learning as newly learned information can be preserved better through memory consolidation.
- We investigate the differences in consolidating newly learned words after sleep in younger and older Chinese-speaking adults.
- Older adults produced lower levels of accuracy in word recall, highlighting an age-related deficit in sleep-mediated memory consolidation. However, older adults could successfully consolidate novel words when their training was sufficiently lengthened.
- We highlight the importance of sleep hygiene and developing AI-based language learning programs to promote successful learning and to help combat age-related cognitive decline.

ISSUE

Population ageing is a global phenomenon, and a pressing issue in emerging markets that account for approximately 85% of the world's population. China has seen increasingly ageing populations due to extended life expectancy and a rapidly declining fertility rate. As the proportion of older adults continues to grow, public health issues pose significant challenges to Chinese society. For instance, age-related cognitive decline may lead to mild cognitive impairment (MCI) or an even more severe clinical disease, such as Alzheimer's (AD). At present, over 10 million people in China are diagnosed with dementia, and this number is increasing rapidly. By 2050, this figure is forecasted to triple.

Learning a new language may improve brain plasticity, which refers to the brain's ability to adapt and reorganize itself in response to new information. Language learning plays a crucial role in delaying the progression of neurodegenerative diseases by stimulating brain plasticity, thereby enhancing quality of life and fostering healthy ageing. Additionally, sleep contributes significantly to facilitating language learning. Newly learned information can be preserved better through memory consolidation during overnight sleep. However, poor sleep quality and habits are expected among older adults, which might diminish the benefits of sleep-mediated memory consolidation for language learning. Given that older adults tend to suffer from sleep disorders and impaired sleep-dependent memory consolidation in their daily lives, it is essential to develop effective interventions incorporating sleep hygiene and language learning programs.

ASSESSMENT

We examined the difference in sleep-mediated memory consolidation between Mandarin-speaking older adults and their younger counterparts in learning novel Cantonese words.

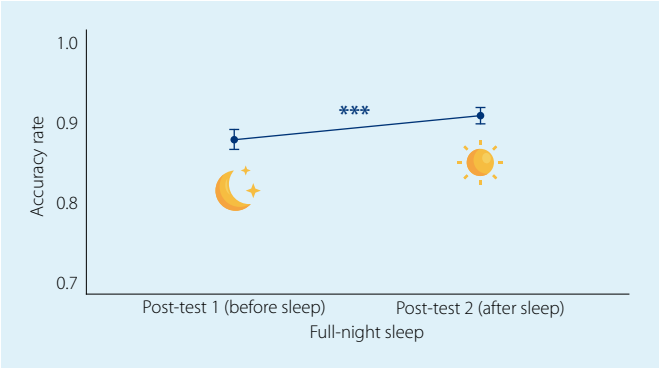
Cantonese Novel Word Learning in Young Adults

46 Mandarin-speaking young adults aged between 19 and 33 were recruited to participate in the Cantonese novel word learning program. Following a language background survey, we found that none spoke Southern Chinese dialects, including Cantonese, or had resided in Hong Kong for more than one year. We also confirmed all participants had regular sleep patterns before the experiment.

On Day 1, participants were asked to learn novel words adapted from Cantonese for a total training length of 6 blocks. They were subsequently assessed using "Post-test 1" to measure their learning outcomes between 8 p.m. and 10 p.m. Following a full-night sleep (12-hour interval) they returned to finish an identical "Post-test 2" between 9 a.m. and 10 a.m. on Day 2.

We conducted a mixed-effect logistic regression model on the word-recall accuracy (binary variable: correct = 0, incorrect = 1) of Post-tests 1 (before sleep) and Post-test 2 (after sleep) to study whether they successfully consolidated novel words through sleep-dependent memory consolidation. Post-test (two levels: Post-test 1 and 2) was entered into the model as an independent variable. The results revealed that the accuracy of word recall among younger adults was significantly improved from Post-test 1 to Post-test 2 after sleep (p-value < .001, see Figure 1). This indicates that Mandarin-speaking younger adults successfully consolidated Cantonese novel words, and that sleep promoted their learning.

Figure 1. Word-recall Accuracy Changes Before and After Full-Night Sleep (Younger adults)



Cantonese Novel Word Learning in Older Adults

To investigate the possibility of age-related decline in sleep-dependent memory consolidation, we recruited 60 Mandarin-speaking older adults aged between 55 and 78 from Nanjing, China, to participate in a similar program of novel word learning. None were found to speak Cantonese. All participants passed the screening with near-normal cognitive ability, which was assessed by the Montreal Cognitive Assessment (MoCA). Their hearing thresholds were measured by pure-tone audiometry. All of them maintained near-normal hearing abilities and self-reported to have regular sleep patterns. We split the participants into 2 groups where half received the same training as the younger adults (six blocks, forming a *shorter* training group), while the other half received a lengthened training (ten blocks, forming a *longer* training group). The words used in training were identical to those used for younger adults for both groups. They completed training and Post-test 1 between 7 p.m. and 9 p.m. on Day 1. After a full-night sleep, they returned and completed Post-test 2 between 7 a.m. and 9 a.m. on Day 2.

Figure 2. Word-recall Accuracy Changes Before and After Full-Night Sleep (Older Adults, Shorter Training Group)

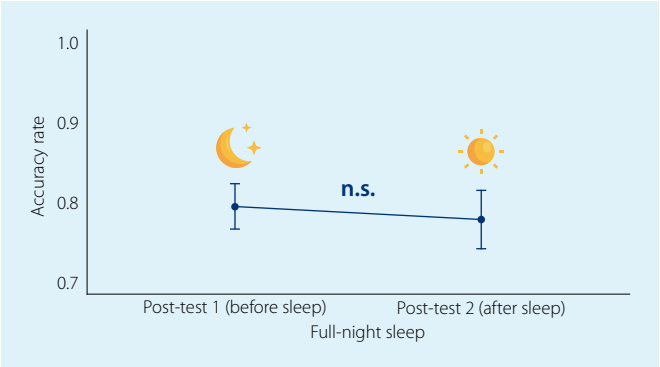
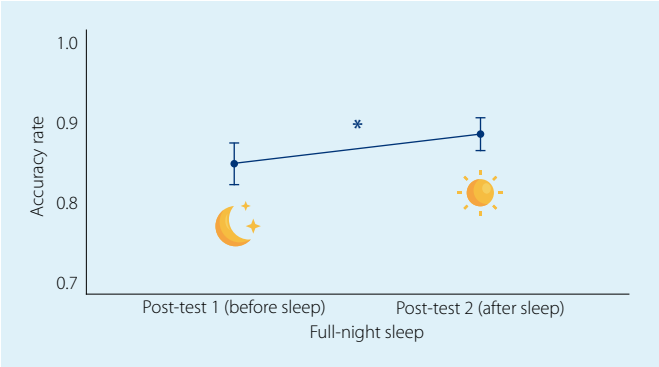


Figure 3. Word-recall Accuracy Changes Before and After Full-Night Sleep (Older Adults, Longer Training Group)



First, we analysed the accuracy change in Post-tests 1 and 2 to test the change in the word-recall accuracy for the shorter training group using mixed-effects logistic regression models. The independent variable was Post-test (two levels: Post-test 1 and 2). Our results indicated no significant change in the accuracy of word recall for older adults in the shorter training group (*p*-value = .35, see Figure 2). This finding suggests that the accuracy of word recall did not improve, even when the training was immediately followed by a full-night's sleep.

We conducted the same analysis on accuracy change in the two post-tests for the longer training group to examine whether older adults would successfully consolidate novel words after lengthened training. The model yielded the main effect of Post-test, suggesting that the accuracy in Post-test 2 was higher than in Post-test 1 (*p*-value < .05, see Figure 3). It indicates the duration of training in word learning impacts memory consolidation. Longer training for older adults produced similar levels of word recall when compared to younger adults. These findings suggest that older adults may show an age-related decline in the memory process, but their memory could be better preserved if they were provided more opportunities for learning.

CONCLUSION

These findings reveal that younger adults could effectively consolidate the novel words learned during training after a period of overnight sleep. In contrast, older adults undergoing the same training produced lower levels of accuracy in word recall, highlighting an age-related deficit in sleep-mediated memory consolidation. However, older adults could successfully consolidate novel words when their training was sufficiently lengthened.

We highlight the importance of sleep hygiene in older adults and in assisting them in developing healthy sleep habits. Future investments should focus on sleep quality by raising public awareness through public and social platforms. These findings also have implications for language learning, which may contribute to alleviating the healthcare burden associated with age-related cognitive and sleep decline amongst the older Chinese-speaking population. We recommend an intervention program that combines a reasonable length of training and healthy sleep habits as a valuable strategy to optimize successful learning in the ageing population. Furthermore, an anticipated rise in dementia cases in China emphasises the urgent need for support from artificial intelligence (AI). In the long term, we argue that it is essential to integrate AI-based language learning programs into development plans to foster brain plasticity in older adults. This initiative would align with the vision of developing China's Great Bay Area as a "smart-ageing city".

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